American River Basin: Downtown Combined Sewer Upsizing Project

Attachment 9: Water Quality and Other Benefits

The Downtown Combined Sewer Upsizing Project provides a broad array of benefits within the American River Basin (ARB) Region and externally to the Sacramento-San Joaquin Delta (Delta). While some of these benefits may be quantifiable via economic analyses, many benefits provided by the project cannot be quantified due to their complex nature. This attachment provides economic analyses of water quality and other benefits expected as a result of implementation of the Downtown Combined Sewer Upsizing Project. In summary, this Project includes the following water quality and other expected benefits:

- Improved water quality resulting from reduced wastewater discharges to regional surface waters
- Avoided costs associated with CSS outflow cleanup
- Protection of public health in the form of avoiding health-related work impacts
- Improved river aesthetic and environment resulting from improved surface water quality
- Avoided litigation resulting from CSS outflow events or potential events

Summary

The Downtown Sewer Upsizing Project is a portion of the City of Sacramento's Combined Sewer System Improvement Program (CSSIP). The City has completed similar improvements downstream, and in conjunction with them, the Downtown Combined Sewer Upsizing Project will reduce combined system overflows (CSOs) to the Sacramento River and reduce flooding of combined stormwater runoff and sewage (termed "CSS outflows") in the downtown area of Sacramento. Thus, the project will meet multiple planning objectives: improve water quality in the Sacramento River (the source of drinking water for millions of Californians), reduce flood damage in the economically vital downtown area of Sacramento, and protect public health by reducing the likelihood and volume of diluted sewage on streets and properties.

The Downtown Sewer Upsizing Project was first conceived by City hydrologists in the 1990's to address the ongoing flooding problems in the Downtown area. Previously completed portions of the project

include the U and S Street Parallel Sewer (completed in 2007) and replacement of existing combined sewer trunk mains with larger pipelines (upsizing) and constructing parallel pipelines in S Street, 5th Street and in the alley between J and K Streets (completed in 2010). These projects served to both increase conveyance to the Sump 1/1A complex, which had been improved in 1997, and reduced the hydraulic grade line in the vicinity of the improvements, including a vulnerable flooding location at 5th and U Streets. It also provided hydraulic improvements to reduce odors and improve pumping efficiency at Sump 1 and Sump 2.

To complete the Downtown Sewer Upsizing Project, it is necessary to continue the "upsizing" in 7th Street to connect with a section upstream that was constructed out of sequence due to timing constraints, and to extend this network of upsized pipes in L, G, F, and 8th Street. For the project to function properly, it is necessary that it be continuous, without bottleneck sections like currently exist. Once completed, the network of upsized and parallel pipes will serve to lower the hydraulic grade line in this portion of the City with critical and high value real estate that has experienced flooding of combined sewer outflows in the past. The Downtown Sewer Upsizing Project will replace existing pipelines with larger pipes, by paralleling the existing pipeline or by connecting new pipes to upsized portions, whichever approach is determined to be most practical. Replacing the pipelines has the added benefit of renewing pipes that have long since exceeded their useful lives. For example, the pipes in 7th Street and S Street are mostly constructed of clay bricks and were constructed in the 1890's. As such, they are not reliable and have been known to fail suddenly.

In addition to the benefits provided to the downtown Sacramento area due to reduced combined sewer overflows, the project will also benefit water suppliers utilizing Freeport Regional Water Authority's (FRWA) intake structure. As the FRWA intake facility is located three miles downstream of downtown Sacramento on the Sacramento River; any combined sewer overflows occurring in the City and entering the river has direct significant negative impacts on the river's water quality and therefore affects water entering the FRWA intake structure.

Summary of Costs and Benefits

As documented in Attachment 4, the budgetary estimate for the Project is $13,109,359. The total present value of the project is $5,335,325 and is based on a 50-year project life cycle, which is consistent with the life cycle assumed in the flood damage reduction benefit analysis and does not include $6,776,064 in sunk costs. The majority of the budget (approximately 90%) for the Downtown Combined Sewer Upsizing Project is for project construction/implementation, with a portion of the budget for planning, environmental review, permitting and design (9%) in addition to smaller amounts for direct project administration, a project contingency, environmental compliance, and construction administration. Project costs will be spread out over an implementation period between September of 2011 and December of 2013. There are no maintenance, administration, operation or replacements costs assumed for this project as the project is a pipeline upsizing and there no anticipated increases in costs for any of these categories.

A summary of the benefits and costs for the project is provided in Table 1. Total present value costs for this project are $5,335,325 and are illustrated in Table 2.

Table 1: Benefit-Cost Analysis Overview

	Present Value
Costs – Total Capital and O&M	$5,335,325
Monetized Benefits	
Flood Control Benefits	
Expected Flood Benefits	$9,803,508
Water Quality and Other Benefits	
Avoided Cleanup Costs	$370,395
Willingness to Pay for Improved Surface Water Quality	$306,029
Avoided Health-Related Work Impacts	$13,286
Avoided Litigation Resulting from CSS Outflows	$2,723,626
Total Monetized Benefits	$13,216,844
Qualitative Benefit or Cost	Qualitative indicator*
Water Quality Benefits	
Reduction in combined sewage discharges and pollutant loading into Sacramento River	++
Other Benefits	
Avoided Public Health impacts associated with direct contact with combined sewage spills in Downtown Sacramento	++
Water Supply Benefits	
Reduction in potential impacts and closure to downstream water supply intake at Freeport	+

O&M = Operations and Maintenance

* Direction and magnitude of effect on net benefits:
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.
– = Likely to decrease benefits.
– – = Likely to decrease net benefits significantly.
U = Uncertain, could be + or –.

Table 2: Annual Cost of Project (referenced as Table 10 in Exhibit C of the Proposition 1E Grant PSP)

Table 2 - Annual Cost of Project Project: Downtown Combined Sewer Upsizing Project									
	Initial Costs	**Operations and Maintenance Costs**						**Discounting Calculations**	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
Year	Capital and Other Initial Costs	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a)+…+(f)	Discount Factor	Discounted Costs (g) x (h)
2009	$0	$0	$0	$0	$0	$0	$0	1.00	$0
2010	$0	$0	$0	$0	$0	$0	$0	0.94	$0
2011	$2,154,031	$0	$0	$0	$0	$0	$2,154,031	0.89	$1,917,080
2012	$2,269,854	$0	$0	$0	$0	$0	$2,269,854	0.84	$1,905,813
2013	$1,909,410	$0	$0	$0	$0	$0	$1,909,410	0.79	$1,512,431
2014	$0	$0	$0	$0	$0	$0	$0	0.75	$0
2015	$0	$0	$0	$0	$0	$0	$0	0.70	$0
2016	$0	$0	$0	$0	$0	$0	$0	0.67	$0
2017	$0	$0	$0	$0	$0	$0	$0	0.63	$0
2018	$0	$0	$0	$0	$0	$0	$0	0.59	$0
2019	$0	$0	$0	$0	$0	$0	$0	0.56	$0
2020	$0	$0	$0	$0	$0	$0	$0	0.53	$0
2021	$0	$0	$0	$0	$0	$0	$0	0.50	$0
2022	$0	$0	$0	$0	$0	$0	$0	0.47	$0
2023	$0	$0	$0	$0	$0	$0	$0	0.44	$0
2024	$0	$0	$0	$0	$0	$0	$0	0.42	$0
2025	$0	$0	$0	$0	$0	$0	$0	0.39	$0
2026	$0	$0	$0	$0	$0	$0	$0	0.37	$0
2027	$0	$0	$0	$0	$0	$0	$0	0.35	$0
2028	$0	$0	$0	$0	$0	$0	$0	0.33	$0

Year	Initial Costs	Operations and Maintenance Costs						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
	Capital and Other Initial Costs	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a)+…+(f)	Discount Factor	Discounted Costs (g) x (h)
2029	$0	$0	$0	$0	$0	$0	$0	0.31	$0
2030	$0	$0	$0	$0	$0	$0	$0	0.29	$0
2031	$0	$0	$0	$0	$0	$0	$0	0.28	$0
2032	$0	$0	$0	$0	$0	$0	$0	0.26	$0
2033	$0	$0	$0	$0	$0	$0	$0	0.25	$0
2034	$0	$0	$0	$0	$0	$0	$0	0.23	$0
2035	$0	$0	$0	$0	$0	$0	$0	0.22	$0
2036	$0	$0	$0	$0	$0	$0	$0	0.21	$0
2037	$0	$0	$0	$0	$0	$0	$0	0.20	$0
2038	$0	$0	$0	$0	$0	$0	$0	0.18	$0
2039	$0	$0	$0	$0	$0	$0	$0	0.17	$0
2040	$0	$0	$0	$0	$0	$0	$0	0.16	$0
2041	$0	$0	$0	$0	$0	$0	$0	0.15	$0
2042	$0	$0	$0	$0	$0	$0	$0	0.15	$0
2043	$0	$0	$0	$0	$0	$0	$0	0.14	$0
2044	$0	$0	$0	$0	$0	$0	$0	0.13	$0
2045	$0	$0	$0	$0	$0	$0	$0	0.12	$0
2046	$0	$0	$0	$0	$0	$0	$0	0.12	$0
2047	$0	$0	$0	$0	$0	$0	$0	0.11	$0
2048	$0	$0	$0	$0	$0	$0	$0	0.10	$0
2049	$0	$0	$0	$0	$0	$0	$0	0.10	$0
2050	$0	$0	$0	$0	$0	$0	$0	0.09	$0
2051	$0	$0	$0	$0	$0	$0	$0	0.09	$0
2052	$0	$0	$0	$0	$0	$0	$0	0.08	$0

Year	Initial Costs	Operations and Maintenance Costs						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
	Capital and Other Initial Costs	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a)+…+(f)	Discount Factor	Discounted Costs (g) x (h)
2053	$0	$0	$0	$0	$0	$0	$0	0.08	$0
2054	$0	$0	$0	$0	$0	$0	$0	0.07	$0
2055	$0	$0	$0	$0	$0	$0	$0	0.07	$0
2056	$0	$0	$0	$0	$0	$0	$0	0.06	$0
2057	$0	$0	$0	$0	$0	$0	$0	0.06	$0
2058	$0	$0	$0	$0	$0	$0	$0	0.06	$0
2059	$0	$0	$0	$0	$0	$0	$0	0.05	$0
2060	$0	$0	$0	$0	$0	$0	$0	0.05	$0
2061	$0	$0	$0	$0	$0	$0	$0	0.05	$0
2062	$0	$0	$0	$0	$0	$0	$0	0.05	$0
2063	$0	$0	$0	$0	$0	$0	$0	0.04	$0
2064	$0	$0	$0	$0	$0	$0	$0	0.04	$0
2065	$0	$0	$0	$0	$0	$0	$0	0.04	$0
	Total Present Value of Discounted Costs (Sum of Column (i))								**$5,335,325**

Comments: This project does not include maintenance costs as the continued maintenance costs associated with sewer cleaning are not affected by the pipeline upsizing. Therefore, there is no incremental increase in the amount of sewer cleaning, repair, and inspection. Project life is considered to be 50 years, which is consistent with the life cycle assumed in the flood damage reduction benefit analysis.

The "Without Project" Baseline

The City's current combined sewer infrastructure is insufficient to handle large storms, resulting in raw sewage overflows onto streets in Downtown Sacramento and into the adjacent Sacramento River. As the downtown Sacramento area is highly populated, the sewage overflows present a public health risk, in addition to associated flood damages and water quality impacts.

In 1990, the Central Valley Regional Water Quality Control Board (CVRWQB) served the City with a Cease and Desist Order that directed the City to devise a plan to reduce its CSO's and CSS outflows. The CVRWQB found that the overflows have resulted in discharges into homes and commercial establishments, which presents a public health threat through human exposure. They found that the overflows are a nuisance as defined in Section 13050(m) of the California Water Code and violate provision E.1 and prohibition A.4 of the City of Sacramento's waste discharge requirements. Provision E.1 states that:

> *E.1. Neither the discharge nor its treatment shall create a nuisance or pollution as defined in Section 13050 of the California Water Code.*

Prohibition A.4 states that:

> *A.4. The bypass of, or overflow from, the combined wastewater collection system is prohibited. The exception to this Discharge Prohibition is the discharges at Discharge points 004, 005, and 007 to the Sacramento River which are restricted by Discharge Prohibition A.3.*

In response to this order, the City developed the Combined Sewer System Improvement Plan (CSSIP) in 1995. Phase 1 of the CSSIP included the Downtown Combined Sewer Upsizing Project. Failure to implement the CSSIP would likely result in violations of the CVRWQB's Cease and Desist Order and waste discharge requirements, resulting in subsequent penalties and fines.

The Downtown Combined Sewer Upsizing Project would increase the conveyance capacity and in-system storage of the combined sewer system, significantly reducing the frequency and volume of combined sewage spills and discharges. Without this project, alternative projects would need to be developed to meet the requirements in the Regional Board's Cease and Desist Order and/or sewer overflows would continue, posing public health and water quality and supply impacts.

Water Quality and Other Benefits

This section describes the water quality and other non-supply benefits generated by this project, including the avoided costs associated with CSS outflow cleanup, the public's willingness to pay for improved river aesthetic and environment resulting from improved surface water quality, protection of public health in the form of avoiding health-related work impacts, and avoided litigation costs resulting from CSS outflow events or potential events. The present value calculations for these benefits are provided in Table 3.

Avoided Costs of CSS Outflow Cleanup

The City typically spends approximately $40,000 per year on cleanup crews to remove debris after combined sewer overflows. This project will reduce the need for cleanup by $30,000 after implementation of the project has been completed through the reduction in flooding events. This cost assumes maintenance activities average five days per year due to CSS outflows and are based on estimated Public Work Services Department personnel expenses. Over the life of the project, this translates to a present value benefit (due to avoided cleanup costs) of $370,395 (in 2009 dollars). The present value of these benefits is shown in Table 3.

Willingness to Pay for Improved Surface Water Quality

Riparian environments have been found to provide a wide variety of benefits, including ecosystem, recreational and aesthetic benefits. There have been a number of studies on the value to protect riparian environments and the public's willingness to pay (WTP) to improve surface water quality of estuaries, rivers, and harbors (Bockstael et al. 1989, Hayes et al. 1992, Sheppard et al. 1993). For example, a survey of the willingness of urban Halifax Regional Municipality (Nova Scotia) residents to pay for improved harbor water quality was undertaken by Corporate Research Associates (CRAI, 1998, 1999). In this study, the WTP reflects the amount of money residents assign to the improvement in quality of life that will accrue from a cleaner harbor. In this study (as quoted in documented in *The GPI Water Quality Accounts, Case Study: The Costs and Benefits of Sewage Treatment and Source Control for Halifax Harbour* by GPI Atlantic, July 2000), the results indicate that 71% of households would be willing to pay between $99.35 per household year (1997$) and $129.20 per household per year for a cleaner harbor. Monetized benefits to be achieved through this WTP include improve water quality, restored aesthetic properties, increases in property values in close proximity to the river and enhanced riverine environment and healthier riverine life.

In evaluating the WTP by Sacramento residents for improved Sacramento River water quality, the lower end of the aforementioned range was assumed to be valid for the Sacramento area. The estimated annual value of this benefit is $28,090. Over the life of the project, this translates to a present value benefit of $306,029 (in 2009 dollars). The present value of these benefits is shown in Table 3.

Because other benefits associated with improved water quality, like improved recreational opportunities and enhanced tourist attraction, would be felt by those outside the immediate downtown area, the monetary estimate of this benefit could be considerably higher than that described herein.

Avoided Health-Related Work Impacts

CSS outflows in downtown Sacramento and into the Sacramento River provide opportunities for the public to come into direct contact with raw sewage and pathogens and chemicals borne by the releases. As estimated by the American Rivers Organization, between 1.8 and 3.5 million people get ill from recreational contact with waters contaminated by CSS every year (*Health Risks of* Sewage, American Rivers as viewed at http://www.americanrivers.org/assets/pdfs/Health_Risks_of_Sewage_fact_sheetb119.pdf). Most of the illnesses are the result of contact with pathogens such as bacteria, parasites and viruses and result in a wide variety of acute illnesses include diarrhea and infections. In evaluating the potential for illness from contact with water-borne pathogens during recreation, the U.S. Environmental Protection Agency

(USEPA) *Draft Guidance for Salt and Freshwater Beaches - Appendices, Appendix B. USEPA Guidance for Recreational Waters and Beaches* was used (USEPA, July 27, 2000). These guidelines recommend that for marine recreational waters, an "Acceptable Swimming Associated Gastroenteritis Rate" of 19 cases per 1,000 swimmers be used.

In their document entitled *A Methodological Approach to an Economic Analysis of the Beneficial Outcomes of Water Quality Improvements from Sewage Treatment Plant Upgrading and Combined Sewer Overflow Controls, EPA-230-11-85-017*, the USEPA evaluated the potential monetary benefits and costs from combined sewer overflow controls. This study looked at impacts relating to swimming, recreational boating, recreation fishing, health, commercial shellfishing, intrinsic and ecological impacts. In estimating the health impacts, the study used lost wages resulting from sick leave from work as their measure of impact. The study assumed that each case lasted one to two days and required sick leave from work but not medical treatment. The study used a dose-response relationship from contact with impacted waters, focusing on swimming-related gastroenteritis and shellfish consumption. In summary, the study found that the range of impacts was from $32.40 to $129.56 per case (1982$). For the evaluation conducted herein, the lower end of this range was assumed.

Miller Park is located immediately down-river from downtown Sacramento and is adjacent to the Sacramento River. As listed on the Sacramento River.org website, activities available at Miller Park include boating (motor, kayaking and canoeing), fishing, swimming, and nature observation (www.sacramentoriver.org/access_site.php?access_site_id=190). Per a survey conducted by the Delta Protection Commission (Sacramento River Recreation Survey) in 1982, an estimated 1,831 recreationists utilized Reaches 12 and 13 of the Sacramento River. (Reach 12 is from Discovery Park to Miller Park and Reach 13 is from Miller Park to Paintersville Bridge.) Assuming that this number has increased to 2,000 since the survey was conducted (a conservative increase of approximately 10%), and assuming that half of those recreationist are in contact with Sacramento River water, 1,000 recreationists have the potential for developing gastroenteritis. Therefore, using the aforementioned USEPA guidelines, 19 of those recreational Sacramento River users will develop a water-related illness that will result in loss of work. Using the lower end of the monetary impacts discussed above, health-related impacts from recreational contact with sewage-contaminated river water are estimated to be $1,219 per year. Over the life of the project, this translates to a present value benefit (due to avoided health-related work impacts from exposure to sewage releases) of $13,289 (in 2009 dollars). The present value of these benefits is shown in Table 3.

Avoided Litigation Resulting from CSS Outflows

As previously mentioned, the California Regional Water Quality Control Board, Central Valley Region (CVRWQCB) served the City of Sacramento with Order No. 90-198 requiring the City of Sacramento's combined wastewater collection and treatment system to cease and desist from discharging waste contrary to requirements. In response to this order, the City formulated and began implementing its Combined Sewer System Improvement Program (CSSIP) to mitigate flooding events from its combined sewer system (CSS). Regulatory orders and litigation are not atypical for combined sewer systems, and the City fully anticipates a lawsuit in the future due to a CSS outflow.

There are multiple recorded incidences where homeowners, businesses, or non-governmental organizations have sued for impacts resulting from CSS outflows. These include the following lawsuits:

- Gary and Virginia Houston versus County of Los Angeles (2004). In this lawsuit, a homeowner in Los Angeles sued the county for insufficient maintenance of sewer lines which resulted in overflows and a flooded basement. This case settled for $210,000 with $233,000 spent in county legal fees.

- San Francisco BayKeeper versus City of San Carlos (2010). In this case, BayKeeper sued the City for outflows to San Francisco Bay. This particular case was settled for $350,000.

- Richard and Lee Gilbert versus City of Cincinnati (2009). In this particular case, an Ohio landowner sought appropriations from the City after sewage overflowed onto his property. No information is currently available regarding legal or settlement fees.

- Finally, the California Sportfishing Protection Alliance (CSPA) recently (2010) sued the City and County of Sacramento for sewage spills into the Delta. This case has currently not been resolved.

Therefore, based on the current political environment and the City of Sacramento's past experiences with water quality-related lawsuits, it was estimated that an average of $250,000 is spent annually on legal fees for CSS and outflow-related (or potential outflow-related) litigation. Therefore, over the life of the project, this translates to a present value benefit (due to avoided CSS-related litigation) of $2,723,626 (in 2009 dollars). The present value of these benefits is shown in Table 3.

Table 3: Present Value of Project Benefits (referenced as Table 19 Exhibit C of the Proposition 1E Grant PSP)

Table 19 - Water Quality and Other Expected Benefits (2009 dollars)
Project: Downtown Combined Sewer Upsizing Project

	(b) Type of Benefit: Avoided Costs of CSS Outflow Cleanup					*(b) Type of Benefit: Willingness to Pay for Improved Surface Water Quality*					*(b) Type of Benefit: Avoided Health-related Work Impacts*					*(b) Type of Benefit: Avoided Litigation Resulting from CSS Outflows*					*Discounting Calculations for Economic Benefits*		
	(C) Measure of Benefit [Unit]: per year					*(C) Measure of Benefit [Unit]: Household*					*(C) Measure of Benefit [Unit]: case*					*(C) Measure of Benefit [Unit]: litigations*							
(a) Year	(d) Without Project	(e) With Project	(f) Change Resulting from Project [e - d]	(g) Unit $ Value	(h) Annual $ Value [f x g]	(d) Without Project	(e) With Project	(f) Change Resulting from Project [e - d]	(g) Unit $ Value	(h) Annual $ Value [f x g]	(d) Without Project	(e) With Project	(f) Change Resulting from Project [e - d]	(g) Unit $ Value	(h) Annual $ Value [f x g]	(d) Without Project	(e) With Project	(f) Change Resulting from Project [e - d]	(g) Unit $ Value	(h) Annual $ Value [f x g]	(h) Total Annual Benefits ($)	(i) Discount Value	(j) Discounted Benefits [h x i]
2009	$40,000	$40,000	$0	$0	$0	0	0	0	$0	$0	0	0	0	$0	$0	0	0	0	$0	$0	**$0**	**1.000**	**$0**
2010	$40,000	$40,000	$0	$0	$0	0	0	0	$0	$0	0	0	0	$0	$0	0	0	0	$0	$0	**$0**	**0.943**	**$0**
2011	$40,000	$40,000	$0	$0	$0	0	0	0	$0	$0	0	0	0	$0	$0	0	0	0	$0	$0	**$0**	**0.890**	**$0**
2012	$40,000	$40,000	$0	$0	$0	0	0	0	$0	$0	0	0	0	$0	$0	0	0	0	$0	$0	**$0**	**0.840**	**$0**
2013	$40,000	$40,000	$0	$0	$0	0	0	0	$0	$0	0	0	0	$0	$0	0	0	0	$0	$0	**$0**	**0.792**	**$0**
2014	$40,000	$10,000	$30,000	$0	$30,000	0	0	0	$0	$0	0	0	0	$0	$0	0	0	0	$0	$0	**$30,000**	**0.747**	**$22,410**
2015	$40,000	$10,000	$30,000	$0	$30,000	0	0	0	$0	$0	0	0	0	$0	$0	0	0	0	$0	$0	**$30,000**	**0.705**	**$21,150**
2016	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.665**	**$205,691**
2017	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.627**	**$193,937**
2018	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.592**	**$183,111**
2019	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.558**	**$172,595**
2020	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.527**	**$163,006**
2021	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.497**	**$153,727**
2022	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.469**	**$145,066**
2023	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.442**	**$136,715**
2024	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.417**	**$128,982**
2025	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.390**	**$120,631**
2026	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.371**	**$114,754**
2027	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.350**	**$108,258**
2028	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.331**	**$102,382**
2029	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.312**	**$96,505**
2030	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.294**	**$90,937**
2031	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.278**	**$85,988**
2032	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.262**	**$81,039**
2033	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.247**	**$76,399**
2034	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.233**	**$72,069**
2035	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.220**	**$68,048**
2036	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.207**	**$64,027**
2037	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.196**	**$60,625**

	(b) Type of Benefit: Avoided Costs of CSS Outflow Cleanup					*(b) Type of Benefit: Willingness to Pay for Improved Surface Water Quality*					*(b) Type of Benefit: Avoided Health-related Work Impacts*					*(b) Type of Benefit: Avoided Litigation Resulting from CSS Outflows*					*Discounting Calculations for Economic Benefits*		
	(C) Measure of Benefit [Unit]: per year					*(C) Measure of Benefit [Unit]: Household*					*(C) Measure of Benefit [Unit]: case*					*(C) Measure of Benefit [Unit]: litigations*							
(a) Year	(d) Without Project	(e) With Project	(f) Change Resulting from Project [e - d]	(g) Unit $ Value	(h) Annual $ Value [f x g]	(d) Without Project	(e) With Project	(f) Change Resulting from Project [e - d]	(g) Unit $ Value	(h) Annual $ Value [f x g]	(d) Without Project	(e) With Project	(f) Change Resulting from Project [e - d]	(g) Unit $ Value	(h) Annual $ Value [f x g]	(d) Without Project	(e) With Project	(f) Change Resulting from Project [e - d]	(g) Unit $ Value	(h) Annual $ Value [f x g]	(h) Total Annual Benefits ($)	(i) Discount Value	(j) Discounted Benefits [h x i]
2038	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.185**	**$57,222**
2039	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.174**	**$53,820**
2040	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.164**	**$50,727**
2041	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.155**	**$47,943**
2042	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.146**	**$45,159**
2043	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.138**	**$42,685**
2044	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.130**	**$40,210**
2045	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.123**	**$38,045**
2046	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.116**	**$35,880**
2047	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.109**	**$33,715**
2048	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.103**	**$31,859**
2049	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.097**	**$30,003**
2050	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.092**	**$28,456**
2051	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.087**	**$26,910**
2052	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.082**	**$25,363**
2053	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.077**	**$23,817**
2054	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.073**	**$22,580**
2055	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.069**	**$21,342**
2056	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.065**	**$20,105**
2057	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.061**	**$18,868**
2058	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.058**	**$17,940**
2059	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.054**	**$16,792**
2060	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.051**	**$15,841**
2061	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.000**	**$0**
2062	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.000**	**$0**
2063	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.000**	**$0**
2064	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.000**	**$0**
2065	$40,000	$10,000	$30,000	$0	$30,000	211	0	211	$133	$28,090	19	0	19	$64	$1,219	1	0	1	$250,000	$250,000	**$309,310**	**0.000**	**$0**
																						Total Present Value of Discounted Benefits over Project Life (Monetized Benefits):	**$3,413,336**
																						Project Allocation:	100.0%
																						Total Present Value of Discounted Benefits (Monetized Benefits):	**$3,413,336**

In addition to the monetized benefits, the Downtown Combined Sewer Upsizing Project provides several non-monetized benefits. These include the following:

Protection of Public Health in the Downtown Sacramento Area

By reducing the volume and frequency of combined sewage spills in the downtown Sacramento area, this project will help prevent the potential for direct public contact with pathogens potentially present in raw sewage. The downtown Sacramento area is an economically vital area and heavily populated, so protecting public health is a significant motivation for the project. As the frequency of the potential direct exposure is not known, nor the degree to which the exposure occurs, the pathway by which the exposure occurs (e.g. direct contact versus ingestion), or the type and degree of potential resulting illness, this impact cannot be quantified.

Additionally, this project will maintain the City's compliance with CVRWQCB's Cease and Desist Order and waste discharge requirements for creating a public health threat, which could result in significant fines and penalties. Again, the degree to which the public health treat occurs (or is perceived to occur) will vary with storm event, political environment and other such factors, the potential savings resulting from the upsizing project cannot be monetized.

Improvement of Sacramento River Water Quality

While Sacramento-area residents' Willingness to Pay for Improvements in Surface Water Quality was monetized (and is discussed in previous sections), the benefits of improved water quality on the Sacramento River ecosystem was not. The Sacramento River is an important source of water for the ecology of the Sacramento-San Joaquin River Delta and for a number of downstream water suppliers, including suppliers downstream of Downtown Sacramento. Reductions in combined sewer spills will help protect water quality for these water suppliers and the Delta ecosystem, including protecting sensitive species and their habitats. As the degree to which this protection/improvement will occur varies with storm event frequency, duration and magnitude and with species and habitat, the associated benefits afforded by the Downtown Combined Sewer Upsizing Project were not monetized in this analysis.

Distribution of Project Benefits

Beneficiaries of this project include the population living, working and playing in and around the downtown Sacramento area, the water suppliers who utilize the Sacramento River as a water source, the Sacramento River ecosystem, and the Delta due to better water quality protections.

Table 4: Project Beneficiaries Summary

Local	Regional	Statewide
Population near downtown Sacramento	Water Suppliers using the Sacramento River; Sacramento River ecosystem; Sacramento River visitors	Sacramento River and the Delta

Project Benefits Timeline Description

The project's water supply benefits will incrementally improve as each phase of the project is completed and the frequency of raw sewage releases decreases. Previously completed portions of the project have reduced combined sewer outflows by about 60% since the project inception. Further improvements are anticipated upon completion of Phases 1, 2 and 3. Phase 1 is anticipated to be completed in December, 2011; Phase 2 is anticipated to be completed in October, 2012; and Phase 3 is anticipated to be completed in September 2013. Incremental benefits will be realized following completion of each project phase.

Potential Adverse Effects from the Project

There are no potential adverse effects associated with the project.

Summary of Findings, Tables

The monetized water quality and other benefit from the Downtown Combined Sewer Upsizing Project are the economic benefits from the avoided costs associated with CSS outflow cleanup, the public's willingness to pay for improved river aesthetic and environment resulting from improved surface water quality, protection of public health in the form of avoiding health-related work impacts, and avoided litigation costs resulting from CSS outflow events or potential events. Non-monetized benefits of the project include improved water quality in the Sacrament River and the protection of public health in downtown Sacramento during and following CSS outflow events. These benefits are listed again in Table 5. Additionally, the proposed project will help the City comply with the Cease and Desist Order issued by the CVRWQCB for the combined sewer system.

Table 5: Qualitative Benefits Summary – Water Quality and Other Benefits

Benefit	Qualitative Indicator
Protects public health by reducing the potential for direct public contact with pathogens potentially present in raw sewage releases from combined sewer overflows in the downtown Sacramento area	+
Improves water quality in the Sacramento River for downstream water suppliers, the Sacramento River ecosystem, and the Delta	+

Omissions, Biases and Uncertainties

This analysis of costs and benefits is based on available data and some assumptions. As a result, there may be some omissions, uncertainties, and possible biases. In this analysis, the main uncertainties are associated with the extent to which this project contributes to mitigating risks posed by the releases of raw sewage as a result of combined sewer outflows. These issues are listed in Table 6.

Table 6: Omissions, Biases, and Uncertainties, and Their Effect on the Project

Benefit or Cost Category	Likely Impacts on Net Benefits	Comment
Protect Public Health	U	The frequency with which the Project will reduce public contact (directly or indirectly) with raw sewage releases will vary based on the severity, duration and frequency of storm events.
Protects Water Quality in Sacramento River	+	The frequency with which the Project will reduce raw sewage releases to the Sacramento River and provide related benefits to downstream water users and the river ecosystem will vary based on the severity, duration and frequency of storm events.
Reduces Cleanup Costs	+	The frequency with which the Project will reduce cleanup costs associated with combined sewage overflows will vary based on the severity, duration and frequency of storm events.
Willingness to Pay for Improved Surface Water Quality	+	Monetized benefits to be achieved through this WTP include improve water quality, restored aesthetic properties, increases in property values in close proximity to the river and enhanced riverine environment and healthier riverine life. However, because other benefits associated with improved water quality, like improved recreational opportunities and enhanced tourist attraction, would be felt by those outside the immediate downtown area, the monetary estimate of this benefit could be considerably higher.

*Direction and magnitude of effect on net benefits:
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.
- = Likely to decrease benefits.
-- = Likely to decrease net benefits significantly.
U = Uncertain, could be + or -.

References

American Rivers. *Health Risks of Sewage.* as viewed at http://www.americanrivers.org/assets/pdfs/Health_Risks_of_Sewage_fact_sheetb119.pdf on April 11, 2011.

Bockstael, N.E., K.E. McConnell, and I.E. Strand. 1989. 'Measuring the Benefits of Improvements in Water quality: the Chesapeake Bay." *Marine Resource Economics*. 6:1-18.

Corporate Research Associates, Inc. (CRAI) 1998. *First Quarter Metro Quarterly Survey*. Halifax, Nova Scotia.

CRAI. 1999. *Metro Public Opinion on Halifax Harbour Cleanup*. Halifax CRA Metro Quarterly Survey. Halifax, Nova Scotia.

Delta Protection Commission. 2007. *The Delta: Sacramento-San Joaquin Delta Recreation Survey – Chapter II. Previous Recreation Surveys.* As viewed at http://www.delta.ca.gov/survey_ch2.htm on April 12, 2011.

Hayes, K.M., R.J. Tyrrell, and G. Anderson. 1992. "Estimating the Benefits of Water Quality Improvements in the Upper Narrangansett Bay." *Marine Resources Economics*. 7:75-85.

Sacramento River.org. *Sacramento River, A Guide to Recreation and Public Access*. As viewed at www.sacramentoriver.org/access_site.php?access_site_id=190 on April 12, 2011.

Sheppard, R., G. Kerr, R. Cullen and T. Ferguson. 1993. *Contingent Valuation of Improved Water Quality in the Lower Waimakariri River*. Agribusiness and Economics Research Unit. Research Report No. 221. Lincoln University, Canterbury, New Zealand.

Wilson, Sara Justine. 2000. *The GPI Water Quality Accounts, Case Study: The Costs and Benefits of Sewage Treatment and Source Control for Halifax Harbour*. GPI Atlantic. July.

United States Environmental Protection Agency (USEPA). 1985. *A Methodological Approach to an Economic Analysis of the Beneficial Outcomes of Water Quality Improvements from Sewage Treatment Plant Upgrading and Combined Sewer Overflow Controls, EPA-230-11-85-017*. November 1.

USEPA. 2000. *Draft Guidance for Salt and Freshwater Beaches - Appendices, Appendix B. USEPA Guidance for Recreational Waters and Beaches*. July.